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JOSEPH B RYAN
RYAN & MASON LLP
90 FOREST AVENUE
LOCUST VALLEY, NY 11560

EXAMINER	
PARSONS, CHARLES E	
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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Paper No. 13

Application Number: 09/368,380
Filing Date: August 04, 1999
Appellant(s): PODILCHUCK ET AL.

Joseph B. Ryan
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 3/4/03.

(1) Real Party in Interest

A statement identifying the real party in interest is contained in the brief.

(3) Status of Claims

The statement of the status of the claims contained in the brief is correct, however upon reconsideration claims 7 and 17 are objected to.

(5) Summary of Invention

The summary of invention contained in the brief is correct.

(6) Issues

The appellant's statement of the issues in the brief is correct.

(7) Grouping of Claims

The rejection of claims stand or fall together as indicted by the Appellant. See page 4 of the Appeal brief.

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of Record

5654771	Tekalp et al	8-1997
6226410	O'Rourke	5-2001

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims: However, upon further consideration the Examiner withdrawals his rejection of claims 7 and 17 and objected to them as shown below.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-3, 11-13 are rejected under 35 U.S.C. 102(b) as being anticipated by Tekalp.

Claim 1: A method for encoding an image sequence, the method comprising the steps of:

generating an estimate of apparent motion within the image sequence utilizing a dense motion field of a portion of the image sequence, wherein the estimate comprises a plurality of motion

vectors each corresponding to an element of the dense motion field, (See column 2 lines 45-50 of Tekalp)

and is generated at least in part as a constrained function of a characterization of motion between elements of the dense motion field and elements of one or more other portions of the image sequence; (See column 8 lines 1-17) Note that the fitting of polygons or defining failure regions are both considered constraints.

and utilizing the estimate to perform motion compensation on at least one of the images of the image sequence. (See column 8 lines 25-47)

Claim 2: The method of claim 1 wherein the image sequence comprises a sequence of video frames. (See column 2 lines 40-43)

Claim 3: The method of claim 1 further including the step of encoding the estimate such that the estimate may be transmitted to decoder for use in decoding encoded versions of one or more of the images of the sequence. (See figure 2A showing the transmission of code signals)

Claim 11: An apparatus for encoding an image sequence, the apparatus comprising:

a motion estimator operative to generate an estimate of apparent motion within the image sequence utilizing a dense motion field of a portion of the image sequence, (See figure 2) wherein the estimate comprises a plurality of motion vectors each corresponding to an element of the dense motion field, (See figure 2) and is generated at least in part as a constrained function of a characterization of motion between elements of the dense motion field and elements of one or more other portions of the image sequence; and a motion compensator having an input coupled to an output of the motion estimator, and operative to utilize the estimate to perform motion compensation on at least one of the images of the image sequence. (See figure 2A)

Claim 12. The apparatus of claim 11 wherein the image sequence comprises a sequence of video frames. (See column 2 lines 40-43 indicating that the image sequence is a sequence of video frames.)

Claim 13: The apparatus of claim 11 further including a loss less coder for encoding the estimate such that the estimate may be transmitted to decoder for use in decoding encoded versions of one or more of the images of the sequence. (See figure 2A item 110. A DCT is a loss less coder)

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) do not apply to the examination of this application as the application being examined was not (1) filed on or after November 29, 2000, or (2) voluntarily published under 35 U.S.C. 122(b). Therefore, this application is examined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

3. Claims 21-26 rejected under 35 U.S.C. 102(e) as being anticipated by O'Rourke.

Claim 21: A method for encoding an image sequence, the method comprising the steps of:

generating an estimate of apparent motion within the sequence, wherein the estimate is generated at least in part utilizing a Markov random field (MRF) model to characterize motion between a given pixel of a motion field and one or more neighbor pixels; and utilizing the estimate to perform motion compensation on at least one of the images of the sequence. (See figure 3A of O'Rourke as well as column 4 line 67

through column 6 line 60.) Also see column 10 and note that the output of 725 and 730, (they are contained in 305), are fed to 750 then to block 755 so MRF's are used in motion estimation.

Claim 22: The method of claim 21 wherein the estimate comprises a plurality of motion vectors, with each of the motion vectors corresponding to a pixel of the motion field. (See figure 7 showing the motion estimation and accompanying explanation in column 10 lines 33-46)

Claim 23: The method of claim 21 wherein the neighbor pixels comprise at least one pixel in the same image as the given pixel, at least one pixel in a previous image of the sequence, and at least one pixel of a subsequent image of the sequence. (See column 5 lines 8-14)

Claim 24: An apparatus for encoding an image sequence, the apparatus comprising:

a motion estimator operative to generate an estimate of apparent motion within the sequence, wherein the estimate is generated at least in part utilizing a Markov random field (MRF) model to characterize motion between a given pixel of a motion field and one or more neighbor pixels; and a motion compensator having an input coupled to an output of the motion estimator, and operative to utilize the estimate to perform motion compensation on at least one of the images of the sequence. (See figure 7)

25. The apparatus of claim 24 wherein the estimate comprises a plurality of motion vectors, with each of the motion vectors corresponding to a pixel of the motion field. (See figure 7 as well as column 10 lines 33-46)

26. The apparatus of claim 24 wherein the neighbor pixels comprise at least one pixel in the same image as the given pixel, at least one pixel in a previous image of the sequence, and at least one pixel of a subsequent image of the sequence. (See column 5 lines 8-14)

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 4-6, 8, 14-16 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tekalp as applied to claim 1 above, and further in view of O'Rourke.

Claims 4 and 14. The method/Apparatus of claim 1/11 wherein the characterization is based on a multi-scale data model which characterizes the motion as a Markov random field (MRF). (See O'Rourke column 4 line 67 through column 5 line 5 showing that he can decompress an image sequence characterized as a Markov Random field. Both inventions estimate motion using dense motion fields, also the use of Markov Random fields was well know in the art at the time the invention was made. Therefore it would have been obvious to one of ordinary skill in the art to apply the concept of Markov Random Field's to Tekalp's invention in order to obtain the current invention.)

Claim 5 and 15: The method/apparatus of claim 4/14 wherein the multi scale data model characterizes at least one of spatial coherence, temporal coherence and scale coherence of the dense motion field. (See Tekalp Column 6 lines 45-65 As well as O'Rourke column 5 line 25-30. According to the applicants specification, a spatial coherence is a result of the Markov Random Field model, which is a smoothing process. Tekalp teaches the use of special gradients, a low spatial gradient in indicative of high coherence. Furthermore, O'Rourke's use of an MRF model would by its very nature characterize a special coherence.)

Claim 6/16: The method/Apparatus of claim 4/14 wherein the multi-scale data model allows a motion vector at a coarse scale to represent an average motion over a set of pixels from a given image of the sequence to

another image of the sequence. (See column 8 lines 17-18 of Tekalp wherein the average motion is represented by the spatial gradients. This average is carried through from scene to scene, or picture to picture.)

Claim 8/18. The method of claim 1/11 wherein the constrained function comprises a first maximum a posteriori (MAP) estimation problem with a constraint on the entropy of the desired estimate. (See O'Rourke column lines 54-60)

Allowable Subject Matter

5. Claims 7, 9,10, 17, 19,20 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim 7/17. The method/apparatus of claim 4/14 wherein the multi scale model utilizes higher order potential functions to characterize structural properties of the dense motion field, and singleton potential functions to characterize the manner in which observations of particular types of dense motion fields affect the likelihood with which such fields occur.

Claim 9. The method of claim 8 wherein the generating step further includes the step of transforming the constrained function into a second MAP estimation problem having at least one parameter uniquely determined by the entropy constraint, wherein the entropy constraint is determined by an amount of bandwidth available for encoding the image sequence.

Claim 10. The method of claim 9 wherein a solution of the second MAP estimation problem minimizes a singleton potential function subject to the entropy constraint, wherein the entropy constraint is computed based on one or more higher order potential functions.

Claim 19. The apparatus of claim 18 wherein the motion estimator is further operative to transform the constrained function into a second MAP estimation problem having at least one parameter uniquely determined by the entropy constraint, wherein the entropy constraint is a function of an amount of bandwidth available for encoding the image sequence.

Claim 20. The apparatus of claim 19 wherein a solution of the second MAP estimation problem minimizes a singleton potential function subject to the entropy constraint, wherein the entropy constraint is computed based on one or more higher order potential functions.

(11) Response to Argument

The Applicant argues 3 points.

First the Applicant asserts that Tekalp does not teach using a constrained function as claimed, see page 6 with respect to claims 1 and 11. The Examiner disagrees. A characterization of motion between elements of the dense motion field and elements of one or more other portion of the image sequence is indeed present in Tekalp. Elements of the dense motion field are areas within that field. In response to dense motion vectors, that is to say an area containing many vectors that are similar in direction and magnitude, Tekalp constrains the areas containing these vectors by grouping them together into separate sections. See column 8 lines 1-33. Therefore, each section or element of the dense motion field is characterized by the motion vectors constrained to that particular area. An area marked off by a polygon is a constrained mathematical function.

Second, the Applicant asserts that O'Rourke does not utilize a Markov random field (MRF) model in an encoder, but a decoder see page 7 with respect to claims 21 and 24. First of all the Examiner would like to point out that a decoder is simply an encoder operating in reverse. Every decoder must be an exact reversal of an encoder otherwise the data will not be decoded properly. As a result if a Markov model is used to encode, it must be used to decode. Therefore the fact that the Examiner pointed to the decoder rather than the Encoder should not preclude the fact that the use of an MRF model is taught. However, O'Rourke does indeed teach the Encoding process see column 3 lines 6-15, as well as using

an MRF model in the Encoding process. See column 5 lines 20-55 wherein O'Rourke clearly teaches that "based on the HMRF image model, the MAP estimate z is the image estimate..." this is in line 25. Then see line 37 where he begins the discussion of his Encoding filter of figure 3A that could be used in the Encoder of figure 2A. See line 40. He then uses the z estimate derived from the MRF in his encoder. He also makes reference to this in column 6 lines 13-22. The Huber minimax function, is a derivative of the MRF. The applicant also argues that O'Rourke teaches a type of conventional block based motion estimation. However, the claim only states that the motion estimation uses an MRF model. A limitation clearly taught by O'Rourke.

Third, the applicant repeats his assertion that O'rourke teaches decoding and not encoding using an MRF. Please see response above. He also states that the Examiner drew an unauthorized conclusion as a motivation to combine both Tekalp and O'Rourke. While the motivation was indeed based on the Examiners own knowledge, the motivation to combine the references comes from the fact that not only was an MRF well known in the art as taught by O'Rourke, but were used in smoothing dense motion fields in order to eliminate any outliers. I.E. vectors that are anomalous to the majority of the vectors in the field. Therefore it would have been obvious to one of ordinary skill in the art to use an MRF model.

With regards to the rejection of claim 5 and 15, the applicant asserts that none of coherence data models are present. The claim was written in the alternative so the Examiner only had to produce one of them. The spatial coherence claimed is a property that is a result of the MRF Data model, which is a smoothing process. See page 5 lines 19-25 of the specification. Furthermore, if an MRF model is being used the spatial coherence is inherent. Similarly a low spatial gradient would be indicative of high spatial coherence. Therefore while the limitations are not explicit, they are implied in not only Tekalp but also O'Rourke.

As for claims 6 and 16, as noted in the rejection above, the average motion is represented by the spatial gradient and used from scene to scene.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

ANDY RAO
PRIMARY EXAMINER

CHRIS KELLEY
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600

CEP
April 21, 2003

Conferees
Chris Kelley SPE
Anand Rao Primary Examiner

JOSEPH B RYAN
RYAN & MASON LLP
90 FOREST AVENUE
LOCUST VALLEY, NY 11560